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CHAPTER 2. Program Management Process and Functional Requirements

2.0 Introduction

NASA programs are major activities within an Enterprise having defined goals, objectives, requirements, and funding levels, and consisting of one or more projects. As explained below, programs vary significantly in scope, complexity, cost, and criticality; however, each is the core of the work that NASA delivers. The Program Manager is responsible for ensuring that program goals address the Enterprise Strategic Plan and that projects, technology, infrastructure, or services supported by the program address the program goals. The Program Manager coordinates program content with the Enterprise, provides leadership and is responsible for the successful accomplishment of the program that meets the needs of the customer. The Program Manager reports directly to the Enterprise unless the program is assigned to the Center Director. This chapter further delineates the requirements for the management of programs, described in four subprocesses: formulation, approval, implementation, and evaluation.

2.0.a The Program Manager is responsible for the total range of program activities, from supporting formulation of program requirements through delivery of the final program products. The Program Manager is responsible for integration, oversight, and assistance to the program's constituent project(s). Responsibilities may include supporting capabilities (e.g., technology development, operations, infrastructure development and maintenance, and data processing and archiving).

2.0.b The program management integration role varies as a function of the level of interdependence of the projects within the program. The following examples illustrate several types of programs. A single-project program (e.g., Cassini) delivers a major capability through completion of one project; in this program type, the Program Manager may also serve in the role of Project Manager and must meet the PAPAC requirements applicable to both programs and projects. For a program which accomplishes its goals and objectives through completion of multiple, synergistic projects wherein each project individually provides a unique product (e.g., EOS), the Program Manager ensures that the projects collectively contribute to an integrated program objective. For programs that deliver an integrated system composed of multiple interdependent projects (e.g., Space Station), end-to-end system integration and delivery is performed at the program level (i.e., the sum of the project deliveries does not produce the system in the absence of program integration). The program management integration role is more limited in other types of programs where the degree of interdependence is less. Examples are Discovery, in which each project stands alone in contributing to a very broad program objective; New Millennium, in which the projects are interdependent in contributing to technology validation but are not synergistically integrated; and technology programs, which can provide a new capability.

2.0.c The Program Manager is responsible for the program safety, cost, schedule, technical performance, and other management requirements contained in chapters 2 and 4. The Program Manager should be knowledgeable in all these areas and utilize the experts from line or functional organizations to assist in program formulation and implementation.

2.0.d The Program Manager should develop a cooperative and performance-oriented team that includes the project managers. It is imperative that team members be mutually supporting and empower each other to do their functions with full and open communication.

2.0.e The relationship between the Program Manager and the Project Manager is critical to the success of both managers. The Program Manager works with the Enterprise to advocate for the totality of the program, including advocacy for projects. The EAA and Program Manager will ensure an effective interface across Government agencies and with the political stakeholders. The Program Manager must monitor the project implementation to relate it to NASA as a whole and the integrated program perspective. The Project Manager focuses on the day-to-day execution of the project by industrial contractors, universities, NASA personnel, and others. It is imperative that both program managers and project managers be mutually supporting and empower each other to do their functions with full and open communication.

2.1 Program Formulation

2.1.a The formulation subprocess establishes the success criteria and defines an affordable program concept and plan for implementation. The formulation subprocess explores the full range of implementation options to meet the overall objectives. Through this subprocess, the top-level requirements are generated for incorporation into the PCA, Program Plans, and/or Project Plans.

2.1.b The primary input to the program formulation subprocess is the FAD, authorized by the EAA, which approves formulation resources, the scope of work, the period of performance, and goals and objectives. The EAA shall assure that the contents of the FAD are appropriate to meet Agency needs and are reasonably achievable within available resources. During program formulation, the PCA, Program Plan, and Project Plans (as appropriate) are developed to define and document the program concept, requirements and success criteria. The responsibility for project formulation is defined in the Program Plan. The content of the FAD, PCA, Program Plan, and Project Plan are described in Appendix E.

2.1.c The program formulation subprocess is the responsibility of the EAA, although the EAA may delegate specific activities. The EAA relies on the advice and recommendations of NASA-chartered panels and scientific advisory committees, which, in many cases, represent customers of the Enterprise. The EAA assignment of projects within the program will be made to Centers in a manner consistent with their mission assignments. Expertise from NASA Centers of Excellence will be integrated into the program as appropriate.

2.1.d All NASA programs, regardless of their size, shall execute the formulation subprocess, addressing all requirements, to provide high confidence that the program is ready to proceed into implementation. The approach to addressing the requirements may be tailored to meet the specific needs of the program, including critical characteristics such as scope, complexity, visibility, cost, safety, and acceptable risk. The formulation activities are executed consistent with the cognizant organization's policies and procedures. The formulation subprocess is an iterative activity rather than a discrete set of linear steps. It begins with customer requirements and strategic planning goals and objectives, all of which are incorporated in the FAD. It continues with interactive execution of its activities, normally concurrently, until subprocess output products have matured and are acceptable to the EAA.

2.1.e The program formulation subprocess activities and the approach to functional requirements can be tailored to match the needs of the unique program. There may be a different approach developed for space and Earth science missions, human space flight, and aeronautics technology, or for different types of programs within these categories, as long as the tailoring is described within the approved FAD, PCA, and Program Plan.

2.1.f As programs are being implemented, they may be impacted by external forces (budget modifications, schedule, or requirements changes) and internal situations (technology challenges, new requirements) and may need to revisit the formulation subprocess to ensure that the planning is consistent with schedule commitments and resource availability. If necessary, agreements (PCA and Program Plan) shall be modified and approved in accordance with the approval subprocess.

2.1.g The formulation subprocess is described in Figure 2-1, which also depicts the principal interfaces with the other three Agency crosscutting processes and the other PAPAC subprocesses. The primary outputs of program formulation are a proposed PCA and Program Plan. A brief summary of the program activities contained within the formulation subprocess is as follows:

(1) Program Planning (paragraph 2.1.1). This activity develops the detailed definition of the program requirements and establishes program control to manage the program formulation subprocess.

(2) Systems Analysis (paragraph 2.1.2). This activity provides the systems analysis and life-cycle costing for concepts and options to meet program objectives.

(3) Technology Assessment (paragraph 2.1.3). This activity examines the program concepts and assesses the technology requirements for feasibility, availability, security, technology readiness, opportunities for leveraging research, and new technologies.

(4) Technology and Commercialization Planning (paragraph 2.1.4). This activity develops the technology options and partnering and commercialization options that satisfy the identified needs of candidate concepts.

(5) Development and Operations Business Opportunities (paragraph 2.1.5). This activity identifies business opportunities for partnerships in the development and operations elements of the program.

[if !supportLists](6) [endif]Assess Infrastructure, and Plan Upgrades/Development (paragraph 2.1.6). This activity minimizes program LCC through utilization of existing or modified infrastructure of NASA, other national and international agencies, industry, and academia to satisfy program requirements.

[if !supportLists](7) [endif]Capture Knowledge (paragraph 2.1.7). This activity collects and evaluates process performance and identifies process lessons learned.
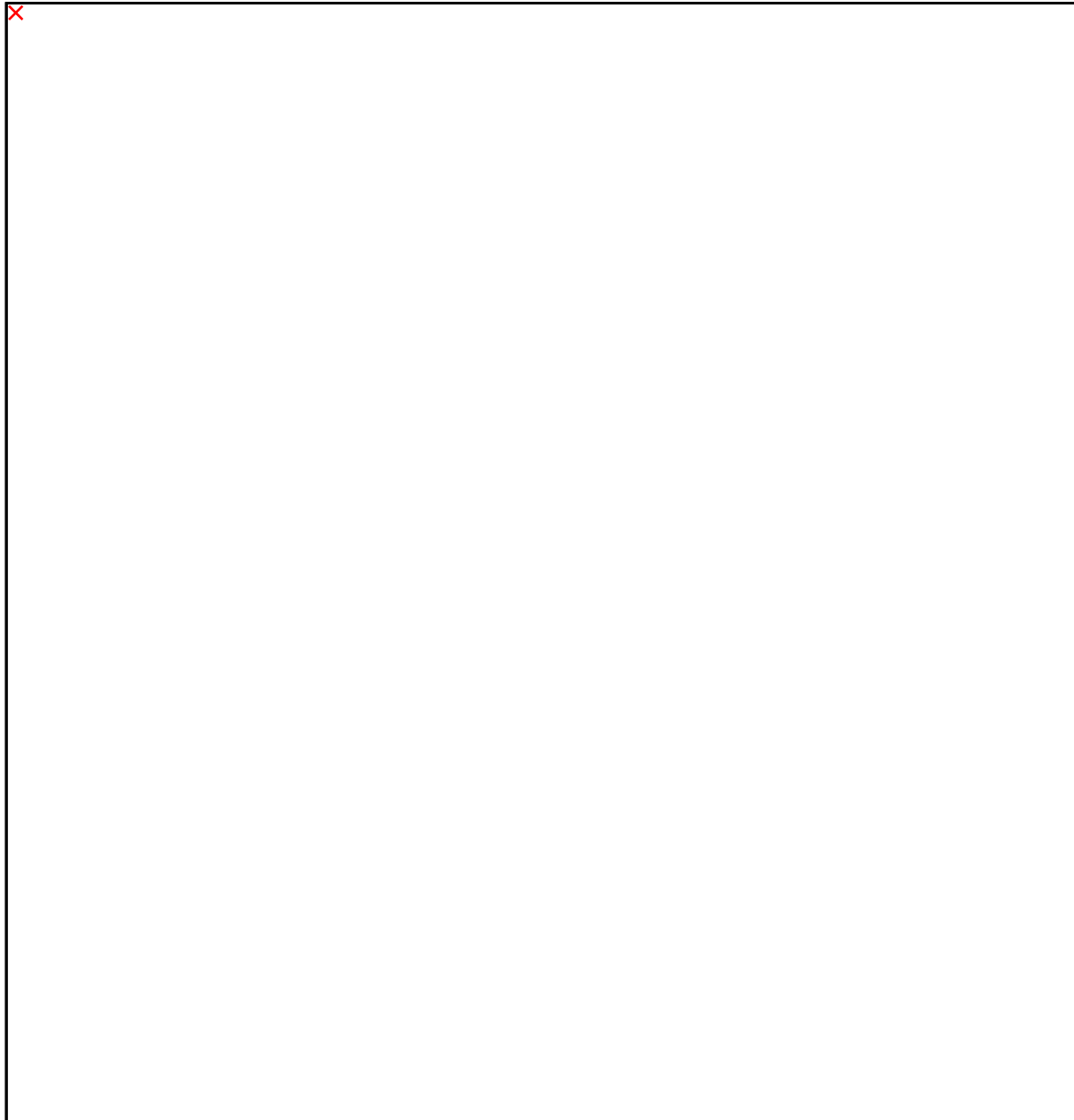

Figure 2-1. Program Formulation Subprocess

2.1.1 Program Planning

2.1.1.1 The Program Manager shall assure that the program team is staffed with personnel with the appropriate skills, abilities, and experience to successfully execute the program. In forming the program team, particular consideration should be given to skills such as financial and acquisition management, risk management, performance management, environmental management, safety, security, and mission assurance (see paragraph 4.1.2.b).

2.1.1.2 As part of the program control activity, the Program Manager shall establish oversight and reporting systems,

which integrate the cost, schedule, and technical performance of the program. The Program Manager supports the annual Program Operating Plan (POP) cycle through the program control activity by providing assessments of affordability as input to NASA funding requirements. Preparation of the program's technical, management, cost, safety, security, risk management, acquisition, and institutional support approach enables a firm Agency commitment to accomplish the program's goals and objectives on schedule and within budget. The program obtains its formal external direction and provides formal internal direction through the Program Planning activity.

2.1.1.3 To accomplish program planning, the program team shall perform the following:

a. As applicable, develop concepts, mission development strategies, data management plans, acquisition strategies, implementation plans, space operations service agreements, launch services agreements, and management plans and incorporate into a preliminary Program Plan (see Appendix E.3).

b. Ensure that the program, for itself and for its constituent project(s), establishes program control and management systems that provide for Work-Breakdown Structure (WBS) development, acquisition management, information technology management, resource management, Earned-Value Management (EVM), facilities, environmental, logistics and schedule management.

c. Establish a configuration management system that provides visibility and control of performance, functional and physical characteristics over the program and product life cycle. Configuration management is applied to requirements, documentation, and software and hardware (qualification, protoflight, flight and ground support).

d. Identify program cost elements, schedule, risks, and performance baseline, and refine throughout the formulation subprocess (see paragraphs 4.2 and 4.4). Program baseline plans are to include project Requirements Reviews (RR) and an Independent Life-Cycle Cost Analysis (ILCCA) when appropriate.

e. Ensure that program success criteria are defined as a portion of the top-level program requirements and flow down as appropriate to lower-level program elements.

[if !supportLists]f. [endif]Ensure that the basic concept of the program is defined and synergistic activities with other NASA, industry, academia, and international parties are considered.

g. Maintain effective communication with the program customers regarding the interpretation and accommodation of requirements.

h. Develop and manage acquisition strategy for the conduct of the formulation subprocess and generate a preliminary acquisition strategy for program implementation (see paragraph 4.5).

i. Define an integrated and comprehensive continuum of reviews (see Appendix F) tailored to the scope, complexity, visibility, cost, safety, and acceptable risk associated with the program.

j. Define the independent review requirements for constituent projects and specify the GPMC consistent with Agency direction.

k. Use risk management planning as a basis for decisions (e.g., to release reserves) to mitigate cost, schedule, technical, environmental, security or safety risks (see Paragraph 4.3).

l. Define metrics for assessment of program performance (see paragraph 4.4.2.2).

m. Review, approve, and monitor progress of all program formulation products.

n. Beginning in early program formulation, work with the Office of External Relations and the EAA to identify potential non-NASA partners and necessary agreements for international or interagency cooperation; all activities and documentation shall be consistent with policy guidelines and with Enterprise or Agency-level agreements with the partners. All commitments shall be obtained prior to Approval for Implementation.

o. Prepare and maintain a preliminary PCA (see Appendix E.-2).

2.1.2 Systems Analysis

This activity provides the systems analysis and LCC analysis necessary to produce feasible concepts and explore a wide range of implementation options to meet program objectives. It considers risks, technology alternatives, operations, business opportunities, schedule, and infrastructure useful to the program. To accomplish systems analysis, the program team shall accomplish the following:

a. Perform trade studies among candidate program concepts that consider content, safety, affordability, risk, technology, security, environmental impact (see Paragraph 4.6.5) and acquisition strategies. Documentation shall be available to approval authorities for the validation or modification of the FAD.

b. Prepare for the adoption of the International System of Units (SI) as the baseline measurement system per NPD 8010.2, Use of the Metric System of Measurement in NASA Programs, early in the formulation subprocess. If a waiver is required, it shall be approved prior to the Requirements Review.

c. Examine program concepts considering estimated life-cycle cost in tradeoffs of commercialization possibilities, technology alternatives, business opportunities, operational needs, and infrastructure availability.

d. Develop program performance requirements and, as applicable, system and subsystem performance specifications.

e. Develop and continually update assessment of program risks and risk-mitigation actions that are integrated with constituent project(s) risk-management activities.

f. Develop the LCC of the program to include the direct, indirect, recurring, nonrecurring, and other related costs for the design, development, production, operation, maintenance, support, and retirement of the program.

2.1.3 Technology Assessment

2.1.3.1 This activity examines the program's concepts and assesses the technology requirements for feasibility, availability, technology readiness, opportunities for leveraging research, and new technologies. Technology assessment is accomplished early in formulation to assure that technology needs are identified and evaluated and that their infusion is appropriately planned. As a program progresses through its life cycle, additional technology assessments may be undertaken to take advantage of promising technologies that may reduce program risk, gain performance, or overcome problems with selected technologies that are not maturing satisfactorily. The technology assessment activity defines which technologies should be incorporated into the program and which should be considered for a crosscutting technology program. Management of technology falls into the following two general categories:

a. Program managed technologies are those that enhance capabilities, reduce risk, improve safety, or reduce cost of planned missions, or that provide fundamental capabilities without which certain specific objectives cannot be met.

b. Crosscutting managed technologies are those that increase capability or reduce cost or risk to such a degree that they enable completely new mission opportunities. The crosscutting technology programs have formulation, approval, implementation, and evaluation subprocesses separate from the programs, which will eventually utilize those technologies.

2.1.3.2 To accomplish the technology assessment, the program team shall perform the following:

a. Identify technologies required to support the proposed program needs and utilize available tools and resources such as the NASA Technology Portal to identify potential technologies. http://nasatechnology.nasa.gov/portalmain.cfm.

b. Assess system concepts to determine technical viability based on current capabilities, existing Agency crosscutting technology activities, and the potential for leveraging commercial technologies and external partnerships.

c. Identify where technology gaps exist, including those significant enough to question the viability for a concept to be realized. Determine the approach to be used to fill the identified gaps.

d. Where gaps in technology solutions are too large to meet the needs of the program, provide this information to the program's originating Enterprise for consideration of incorporation into the Agency's technology planning process and possible crosscutting technology programs.

e. Identify technologies that have distribution restrictions on the software, hardware, or data.

2.1.4 Technology and Commercialization Planning

This activity plans the technology approaches that satisfy the identified needs of candidate concepts. It also develops options for partnering and commercialization. Further, this activity provides for the development of plans and the establishment of partnerships to transfer technologies, discoveries, and processes with potential for commercialization. To accomplish technology and commercialization planning, the program team shall perform the following:

a.b. Explore innovative avenues to expand participation and infuse the latest technological and commercial capabilities into the program.

c. Explore ways the assets (technology, discoveries, innovations, tools, processes, or software), developed as a byproduct of the program execution, can be infused into industry.

d. Identify, verify, and report success stories to the Center Commercialization Office that have resulted from partnerships, transfer, or commercialization of assets.

e. Ensure that the plans for technological or commercial cooperation include a full description of the opportunities for partnering, the potential partners, the need for protection of intellectual property, the likelihood of the partnership coming to fruition, the expected contribution (personnel, facilities, Independent Research and Development (IRAD), and other funding) and the confidence that the partnership will remain in force.

f. Where possible, integrate NASA plans with the technology and commercialization plans of its U.S. customers. Potential U.S. cooperative technology and commercialization opportunities are to be explored and, where advantageous to NASA, agreements enacted.

g. Ensure that the planned technology exchange, contracts and partnership agreements comply with all laws and regulations regarding export control and the transfer of sensitive and proprietary information.

2.1.5 Development and Operations Business Opportunities

In this activity, the Program Manager identifies business opportunity partnerships in the development and operational elements of the program. Business opportunities in the development part of the program will assess the resources and aligned interests of other Government agencies, industry, academia, and international entities, to provide one or more of the program end-item deliverables and reduce LCC. The business opportunities for the operational element will consider communications, tracking, and data processing functions. Development of an operations concept will examine the viability of autonomous control and distributed versus centralized operations, as well as the possibility of commercial operation opportunities. This activity is interdependent with the assessment and planning specified in paragraph 2.1.6 to the extent that an integrated set of outputs is required. Partnering opportunities and relationships identified through these activities will be assessed for feasibility through the analysis specified in paragraph 2.1.2 and the final negotiated agreements. To accomplish this assessment, the program team shall perform the following:

a. Assess development and operational requirements, evaluating alternative approaches to meeting program needs while minimizing Agency resources.

b. Develop an approach for disposition of program assets (orbital and other) after the end of their useful life.

c. Assess teaming and partnering options, including commercial ventures, for the development and operational elements to reduce the project LCC.

d. Develop requirements for communications, tracking, data processing, and mission operations. NASA services shall be used unless a more cost-effective, lifecycle approach can be proposed.

2.1.6 Assess Infrastructure and Plan Upgrades/Development

This activity assesses the capability of the Agencywide infrastructure to satisfy program requirements. Resources in other Government agencies, industry, academia, and international entities will also be considered to minimize program LCC's. To accomplish this assessment, the program team shall perform the following:

a. Identify capability gaps and produce plans and required documentation for infrastructure upgrades or new development, including environmental compliance (see paragraph 4.6.5), and reflect the results in the Program Plan.

b. Perform cost trades to enable meeting requirements through synergy with other programs, thus avoiding costly duplication of support facilities.

c. Perform an appropriate level of analysis to identify the operations and maintenance cost drivers and to assess impacts on the Agency's infrastructure and program logistics support needs.

d. Identify testing requirements (e.g., ground and flight facilities, research aircraft and data needs) and verify infrastructure capability.

2.1.7 Capture Knowledge

The objective of this activity is to enable future programs to benefit from lessons learned during the formulation subprocess.

2.1.7.1 Process-related lessons learned shall be identified and provided to the Chief Engineer to improve the PAPAC process. Activity lessons learned shall be provided to the Lessons Learned Information System (LLIS) maintained at GSFC.

2.1.7.2 Documentation associated with program formulation history which includes the significant events, options studied, trade-offs made, resources expended, time consumed, and any other performance information shall be maintained in order to assist other programs with their execution.
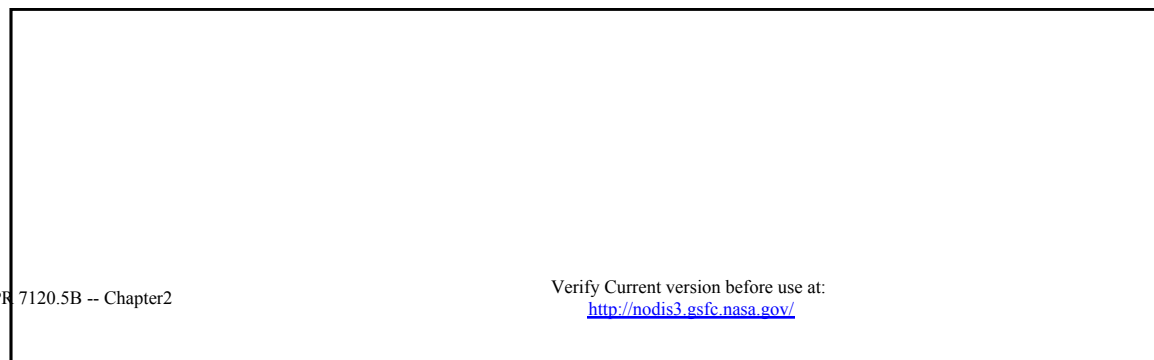
Figure 2-2. Program Approval Subprocess

2.2 Program Approval

2.2.1 The program approval subprocess determines a program's readiness to proceed with implementation. It should result in transition from formulation to implementation. Subsequent approvals may be required as a result of changes to the PCA and Program Plan based on budgetary, technical, or institutional considerations. Each program shall execute the approval subprocess.

2.2.2 Within NASA, the Administrator has sole authority to approve all new programs. NASA will undertake only programs whose objectives are clearly articulated and consistent with the NASA Strategic Plan and Enterprise Strategic Plans. Only those programs for which a firm life-cycle cost, schedule, and content commitment can be made will be approved. The program approval subprocess flow is presented in Figure 2-2. The program budget direction/constraints, NASA and Enterprise Strategic Plans, and decisions made from recommendations by the Executive Council (EC) are a direct input to program approval, through the approving official. To begin the approval subprocess, the EAA shall provide to the Agency PMC a proposed PCA and Program Plan.

2.2.3 Information from the evaluation subprocess developed through independent review(s) during formulation is provided to the Agency PMC. Based on the Agency PMC recommendation, the Administrator signs the PCA with the EAA, thereby approving the PCA. The EAA, the Program Manager, and other authorities, as documented in the PCA, sign the Program Plan. A signed PCA and Program Plan are provided for the implementation subprocess as the baseline for detailed implementation planning and execution.

2.2.4 The PCA shall be updated if changes are required. The EAA will classify proposed PCA changes as either major or minor. Major changes represent significant impacts to requirements, schedule, resources, risks, or agreements; all other changes are minor. The Deputy Administrator has the authority to approve a revised PCA with minor changes. All major PCA changes shall be forwarded to the Administrator for approval. All changes, major and minor, are logged in the activities log of the affected PCA.

2.3 Program Implementation

2.3.a The program implementation subprocess implements the approved program requirements and plans. All programs shall execute the implementation subprocess. In tailoring the implementation subprocess, all requirements shall be addressed. The approach to addressing the requirements may be tailored to meet the specific needs of the program, including critical characteristics such as scope, complexity, visibility, cost, safety, and acceptable risk. The

implementation subprocess translates the input products from the formulation and approval subprocesses into the production of output products and services for the designated customers.

2.3.b Each program executes the following implementation activities (see Figure 2-3):

(1) Program Control. (paragraph 2.3.1) This is an activity through which the Program Manager provides direction and exercises control over the program.

(2) Customer Advocacy. (paragraph 2.3.2) This activity maintains contact with customers and advocacy for customer objectives, plans, and requirements implementation.

(3) Requirements Management. (paragraph 2.3.3) This is an activity that converts top-level requirements into implementation requirements and maintains configuration management of requirements documentation.

(4) Design, Develop, and Sustain. (paragraph 2.3.4). This activity produces the specific program systems, hardware, and software.

(5) Deliver Products and Services. (paragraph 2.3.5) This activity delivers the program products and services, including science and technology. It includes operations of delivered systems to produce data for customers.

(6) Capture Knowledge. (paragraph 2.3.6) This activity collects and evaluates process performance metrics to identify process corrective actions and/or to communicate the lessons learned in using these processes.
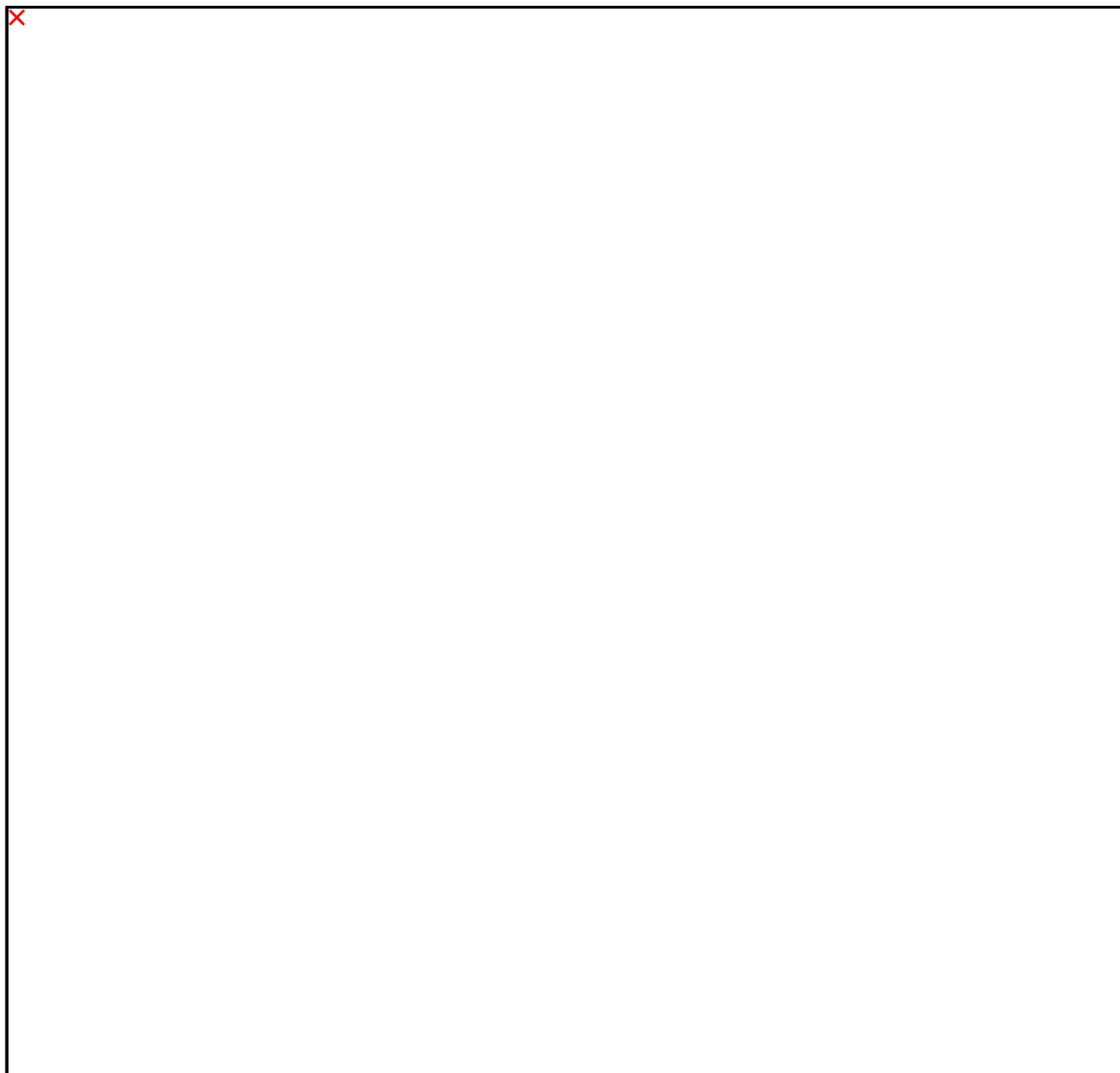
Figure 2-3. Program Implementation Subprocess

2.3.1 Program Control

2.3.1.1 This is an activity through which the Program Manager provides direction and exercises control over the

program. The purpose of this activity is to ensure that program implementation is conducted in an effective manner, beginning with and maintaining a thorough understanding of program requirements and the resources required to meet those requirements. The activity maintains PCA's, program plans, budgets, schedules, and top-level performance requirements that are inputs to the implementation subprocess. This activity develops and integrates the overall implementation approach and provides management oversight of all aspects of the program.

2.3.1.2 This activity includes program control and management of all program implementation activities to meet performance requirements within cost, schedule, and quality commitments in compliance with baseline program documentation and the management systems requirements in chapter 4. This activity ensures the collection, tracking, reporting, and management of the program according to performance metrics. The program team shall perform the following:

a. Maintain the program within the scope of the baseline agreements and documents and assess scope changes and impacts caused by customer and evaluation subprocess recommendations, budgetary processes, performance assessments, external agreements performance, and other factors. The Program Plan and PCA shall be updated, as required, to maintain compatibility between the plan and the resources available. Prepare recommendations and request rebaselining through the approval subprocess.

b. Implement integrated planning to maintain program requirements and associated rationale, document the roles of implementers and program interdependencies, and maintain the program management structure.

c. Perform resources management per the requirements in paragraph 4.2 to ensure the appropriate acquisition of and distribution of resources and support the Agency budget process document and manage work authorization including scope, schedule, and budget.

d. Manage acquisition per the requirements in paragraph 4.5 to maintain acquisition plans, execute procurements and agreements in accordance with Federal law and regulations, and ensure monitoring and reporting of activities related to contract and nonprocurement instruments.

e. Manage schedules per the requirements in paragraph 4.4.3 to maintain the baselined schedule consistent with program milestones and the program WBS.

f. Ensure that baselined program documents, including the product baseline, are maintained under configuration management.

g. Assess and report performance per the requirements in paragraph 4.4 to include the assessment of program status against established metrics, the evaluation of variances, and any GPMC assigned actions.

h. Implement risk management per the requirements in paragraph 4.3 to identify risk and its impact and prioritize risks for mitigation or elimination and maintain the Risk Management Plan.

i. Periodically assess the adequacy of resources, including margins, to meet the program requirements and if margins become inadequate, develop and implement a recovery plan.

j. Maintain an effective safety and mission success activity throughout all design, development, delivery, operations and retirement or disposal activities per the requirements in paragraph 4.6.

k. Conduct an integrated continuum of reviews as specified in the Program Plan, based on the guiding principles and major classes of reviews provided in Appendix F. Address, close, and report issues in a timely manner and apprise management of changes to residual risks.

2.3.2 Customer Advocacy

2.3.2.1 The purpose of this activity is to proactively consult and involve customers in the implementation subprocess to ensure customer satisfaction with delivery of quality products and services within budget and schedule commitments. It provides internal implementation process advocacy of customer interests in program decision forums.

2.3.2.2 The Program Manager shall ensure that the customers are an integral part of the program to clarify requirements and assess implementation progress against commitments.

2.3.2.3 The Program Manager shall implement customer advocacy per the Program Plan.

2.3.3 Requirements Management

2.3.3.1 This activity flows down higher level requirements into more specific requirements and allocates them to lower level program elements. A configuration management process is used to ensure compatibility across multiple program elements. To accomplish Requirements Management, the program team shall perform the following:

a. Define program requirements, consistent with the PCA and the Program Plan technical content, cost, schedule, security requirements, and institutional requirements.

b. Perform program systems engineering and analysis to ensure that cost-effective requirements are specified and to refine and validate LCC's.

c. Collect and allocate program requirements into implementable elements.

d. Document, control, and verify program requirements.

e. For programs that deliver systems, develop a specification that includes Government-furnished equipment/products and operations requirements.

2.3.3.2 For some programs, packaging of implementation requirements is effectively a project-defining activity. These packages become the initial requirements for initiating projects or for changing the scope of existing projects. For those programs, requirements management is the major activity responsible for defining the project's content within the program.

2.3.4 Design, Develop, and Sustain

2.3.4.1 This activity develops the specific technology and/or systems and establishes the systems supporting infrastructure for sustaining engineering, logistics, continuing production and operations. All program teams focus on oversight of, and assistance to, the constituent project(s). For programs that deliver systems, the integration of design, development, manufacturing, verification and validation, certification, operations capability development, and overall systems development monitoring and control are major elements of this activity.

2.3.4.2 The program team shall perform the following as applicable:

a. Conduct analyses and reviews of integrated system designs to optimize design for program requirements and direct program activity accordingly.

b. Execute contracts and nonprocurement instruments and conduct appropriate surveillance commensurate with risk.

c. Develop, review, and execute a verification and validation plan that includes software/hardware integration and appropriate independent verification and validation of software.

d. Ensure incorporation of new technology/commercialization per technology and/or commercial development plan(s) and validate the program technology utilization approach.

e. Ensure interface control between various program elements.

f. Establish and maintain logistics support capability to sustain delivered hardware and software systems, consistent with intended mission requirements and plans.

g. Ensure that critical facilities, equipment, and materials are available when needed.

h. For existing operations infrastructures that deliver cross-program products and services, provide design, implementation, and sustaining engineering for technology, commercial, obsolescence, and capacity upgrades.

i. Provide sustaining engineering for efficiency enhancements and for safety and obsolescence plan development and execution.

j. Use technical standards with preference given to non-Government voluntary consensus standards. Maintain a listing of program office required Government and non-Government standards and specifications, and evaluate the impact of relevant changes (http://Standards.msfc.nasa.gov/).

k. Implement the SI (metric me , asurement system) as planned in program formulation.

l. Ide , ntify, document, and control baseline engineering and technical management information.

m. Protect intellectual property and technology in accordance with paragraph 4.7.

n. Assure that a security risk assessment is accomplished.

2.3.5 Deliver Products and Services

This activity ensures delivery of the program and constituent project(s), products, services, and/or technology to the customer. It includes operations of delivered systems and oversight of delivered project systems and production of products for science and technology customers. Routine interaction and outreach with the program/project customer community to pursue customer satisfaction is a critical function. This activity also performs program retirement/closeout planning and execution. To perform these functions, the following shall be accomplished:

a. Ensure that deliverable products and/or services and operations are compliant with all program requirements and customer agreements for technical, cost, schedule, safety, security, and quality performance.

b. Ensure, for those products requiring transfer of custodial responsibility, that acceptance/turnover activities and material are addressed.

c. Refine and prepare to implement plans for disposition of program assets (orbital and other) after the end of their useful life.

d. Collect and analyze metrics and report program status.

2.3.6 Capture Knowledge

The objective of this activity is to enable future programs/projects to benefit from lessons learned during the implementation subprocess.

2.3.6.1 Process related lessons learned shall be identified and provided to the Chief Engineer to improve the PAPAC process.

2.3.6.2 Documentation associated with program implementation, including engineering and technical management information as well as resources expended, time consumed, and any other performance information, shall be maintained in order to assist other programs/projects with their execution.

2.4 Program Evaluation

2.4.a The evaluation subprocess provides an independent assessment of the continuing ability of the program to meet its technical and programmatic commitments and to provide value-added assistance to the Program Manager. It is applied throughout the life cycle of programs and consists of periodic independent reviews during the formulation and implementation of a program. These, together with the other classes of reviews delineated in Appendix F, shall be appropriately combined to comprise the integrated continuum of reviews required in 2.1.1.3.i. The Agency Independent Program Assessment Office and the Systems Management Office at each Center are key resources to Agency and Center senior managers, PMC's and program/project managers in executing independent assessment of programs and providing recommendations on how to improve.

2.4.b The evaluation subprocess, shown in Figure 2-4, utilizes review teams composed of knowledgeable, independent experts from outside the advocacy chain of the program. Evaluation supports the approval subprocess by providing findings and supporting data necessary to arrive at decisions either to proceed or not to proceed with subsequent portions of program life cycles. Evaluation during formulation assesses whether programs support the Agency goals and strategic planning and that programs can be successfully conducted within allocated resources and applicable constraints. Evaluation during implementation assesses whether programs are being successfully executed according to plans and provides recommendations for enhancing the technical and programmatic performance of programs.

2.4.c All programs shall execute the evaluation subprocess. The approved FAD, PCA and Program Plan shall specify the requirements, timing, objectives and convening authority for independent reviews. The evaluation subprocess should be planned to minimize disruptions to the program and avoid unnecessary duplications. Prior to independent reviews, the current FAD, PCA, Program Plan, and other appropriate program documentation are provided to support evaluation. Independent reviews shall address, as a minimum, technical requirements and achievements, schedules, projected LCC, issues, concerns, safety, security, environmental compliance, risk management plans/status, and other program metrics.

2.4.d Note that requests for audits, additional reviews and assessment of programs may come from the Congress, the NASA Inspector General, the General Accounting Office (GAO), advisory groups such as the Space Science Advisory Committee, and other similar sources. The NASA Chief Engineer shall coordinate responses to external review requests, work in concert with the EAA and the office responsible for management controls to disposition such requests, and coordinate the scheduling of such activities with the Program Manager and GPMC, when requested.
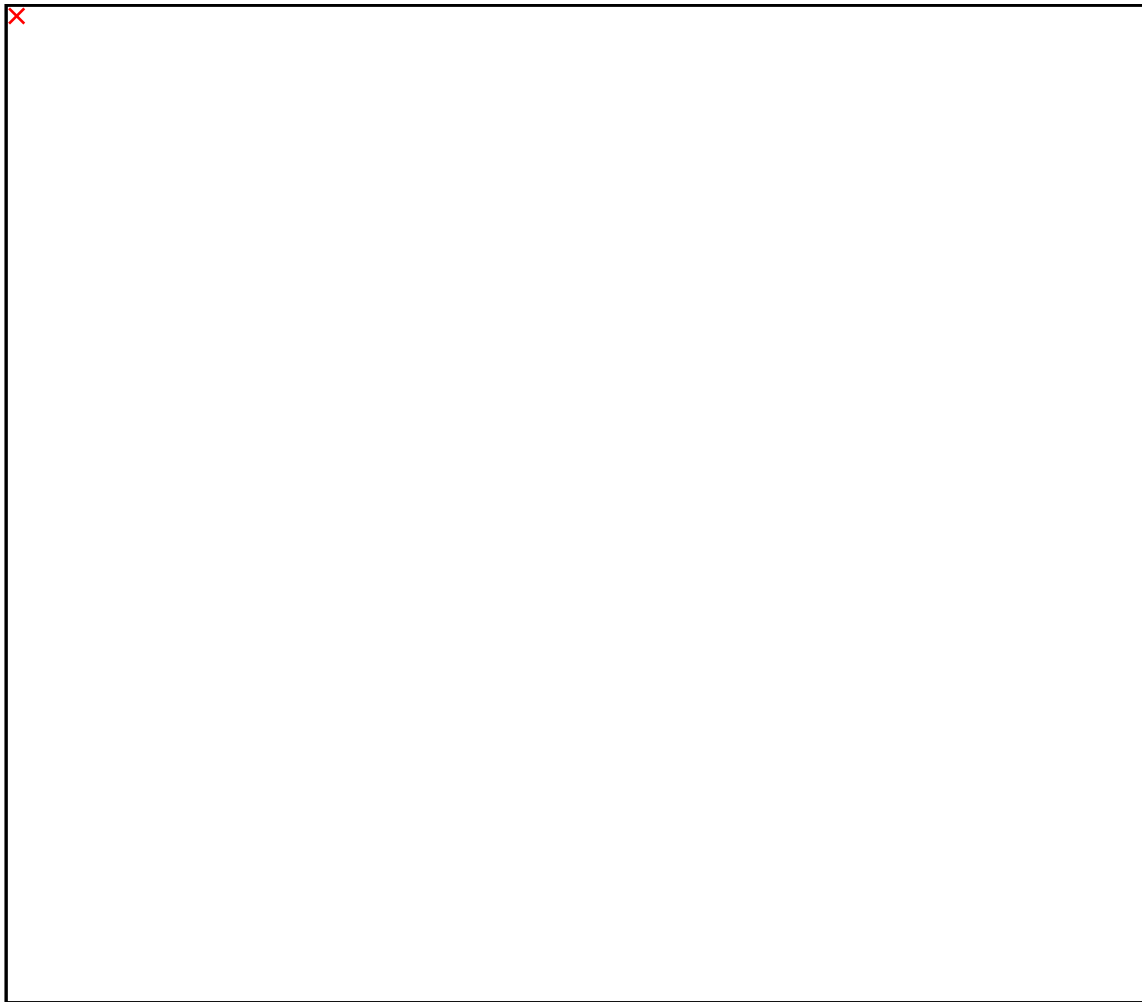
Figure 2-4. Program Evaluation Subprocess

2.4.1 Plan and Conduct Independent Reviews

2.4.1.1 This activity plans and conducts the specific reviews defined in the FAD, PCA and Program Plan. Requirements, implementation plans, data, and customer feedback are all made available for the evaluation subprocess.

2.4.1.2 The purpose and methodology of each review shall be defined prior to initiating the review.

2.4.1.3. During the formulation subprocess, in preparation for requesting approval, a Non-Advocate Review (NAR) shall be conducted to determine the readiness of the program to proceed into implementation. The NAR shall include an ILCCA where applicable. Additional independent reviews (e.g., Independent Assessment) may be required during formulation by the Agency PMC or EAA. Unless otherwise delegated, independent reviews during program formulation shall be reported to the Agency PMC and shall be conducted by the Independent Program Assessment Office (IPAO).

Note that when a project under a program has an estimated NASA LCC greater than $150M, an ILCCA is required during formulation in conjunction with initiating the preliminary design. The results of that ILCCA shall be certified by the Chief Financial Officer (see paragraph 3.4.1.3).

2.4.1.4 Concurrent with the implementation subprocess, evaluation shall consist of periodic (approximately annual) independent reviews, referred to as Independent Implementation Reviews (IIR), which measure program performance and compare that performance with the Program Plans. Unless otherwise delegated, independent program reviews conducted during implementation shall be reported to the Agency PMC and shall be conducted by the IPAO.

2.4.1.5 The GPMC chair, or designee, shall concur that review teams are composed of knowledgeable, independent experts from outside the advocacy chain of the program, and customer representatives, as appropriate.

2.4.1.6 Special-purpose independent reviews (e.g., Termination Review) shall be conducted, as required, at the direction of the GPMC. Requests for special purpose reviews may come to the GPMC from customers, line organizations, or others. Elements such as the anticipated inability of a program to meet its commitments contained in controlling agreements and plans, including a projected cost at completion that exceeds the costs allowed by the PCA; an unanticipated change in Agency strategic planning; or an unanticipated change in the NASA budget shall be considered prior to convening a Termination Review.

2.4.2 Capture Knowledge

The objective of this activity is to enable future programs to benefit from lessons learned during the evaluation subprocess.

2.4.2.1 Process related lessons learned shall be identified and provided to the Chief Engineer to improve the PAPAC process.

2.4.2.2 Documentation associated with program evaluation as well as resources expended, time consumed, and any other relevant information shall be maintained by the Systems Management Office (SMO) and/or IPAO in order to assist other programs with their execution.

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